Repricing Gold: Coverage Targets for Fiat Liquidity and the Dynamics of a Peg

Douglas C. Youvan

doug@youvan.com

www.youvan.ai

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If a modern economy tried to "gold-back" today's liquid money, the gold price wouldn't inch—it would **reprice**. The arithmetic is simple but under-discussed. Let M be the money to cover (choose: base, M1, or broad money), O the ounces available (choose: official reserves, tradable float, or all above-ground stock), and c the desired coverage fraction (0–100%). The implied clearing price is P_implied = (c * M) / O. Because money stocks are large, while official gold is small and mine supply is slow, even modest coverage targets imply **five-figure** gold. In practice the path is not algebraic but **path-dependent**: the tradable float is thin, hoarding rises into a revaluation, and policy frictions (convertibility rules, capital controls, two-tier markets) shape the outcome. This paper formalizes the coverage arithmetic, maps the design space for partial vs. full backing, and examines transition mechanics—who buys from whom, at what cadence, and under which convertibility promises. We contrast quiet arithmetic with noisy market microstructure, drawing lessons from 1933–34, the Bretton Woods years, and the 1968 two-tier experiment. Finally, we translate the framework into investor and policy playbooks, including scenario tables (10%, 20%, 40%, 100% coverage), monitoring dashboards, and clear falsifiers. The goal is clarity: if you change M, O, or c, how much does gold need to move—and what breaks first, markets or policy?

Keywords: gold revaluation, convertibility, coverage ratio, money supply, base money, M1, M2, stock-to-flow, central bank reserves, two-tier market, capital controls, real interest rates, USD, monetary premium, hoarding dynamics, transition policy, investor positioning.

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References

1. Motivation and Framing

We frame the question as a **clean, algebraic counterfactual**: *If a policymaker wanted some fraction of today's liquid money to be gold-backed, what gold price would clear?* The point isn't to advocate a peg, but to make the trade-offs legible.

Why now? Because a few forces keep reviving "coverage" talk: (i) record global liquidity since 2020, (ii) bouts of high inflation and volatile **real** rates, (iii) rising central-bank gold buying and reserve diversification, (iv) geopolitical/FX fragmentation and sanction risk, and (v) periodic banking stress that reminds everyone what "convertible into what?" really means. Coverage arithmetic gives a neutral way to reason about these debates without hand-waving: pick the money you mean, pick the ounces you actually have (or could get), pick the fraction you promise, and the **implied price** falls out mechanically. After that, the hard problems are *institutional design* (convertibility rules, who is eligible, two-tier markets) and *path dependence* (thin tradable float, hoarding, capital controls) — but at least the baseline math is transparent.

1.1 From fiat to metal: why talk about coverage now

- **Fiat reality:** Money creation rides bank lending and central-bank balance sheets, not metal stocks. There is no convertibility constraint.
- **The re-emerging question:** If a jurisdiction wanted to *signal* discipline (fractional backing) or to *bind* policy (hard peg), what **price** would align outstanding money with available gold **without** forced deflation?
- **Usefulness:** Coverage math separates *narrative* from *numbers*. If the target price is an order of magnitude above spot, the policy implies a **revaluation**, not a gentle glide path — and the frictions (float, hoarding, two-tier markets) become the real story.

1.2 Definitions: M, O, coverage c, and P_implied = (c*M)/O (ASCII-safe)

Money to cover (M) — choose explicitly

- base_money = currency_in_circulation + bank_reserves_at_CB
- M1 = currency_held_by_public + demand_deposits (checking)
- M2 (broad) = M1 + savings/time_deposits + retail_MMFs (definitions vary by country)
- global_Mx = sum over countries of local_Mx * FX_USD_per_local (mind double counting of offshore/eurodollar aggregates)

Ounces available (O) — choose explicitly

- official_reserves_oz = central_bank + treasury fine ounces
- above_ground_oz = all gold ever mined (jewelry, private bars/coins, CBs, ETFs)
- tradable_float_oz = subset realistically offered near the new price (<< above_ground_oz; scenario-dependent)

Coverage fraction (c)

- c in [0,1]. Examples: c = 0.20 for a 20% fractional cover; c = 1.00 for full cover. State whether coverage applies to base_money, M1, or M2.

Implied clearing price (static algebra)

Units: M in USD (or chosen unit); O in fine troy ounces; P in USD/oz.

P_implied = (c * M) / O

Interpretation: the **one-time price** that would make the promised fraction of the chosen money aggregate convertible into the chosen ounce set, assuming holders could actually obtain metal at that price.

Two policy modes (be explicit)

- **Price rule:** set P_target and let coverage float (convertibility honored at that price; CB buys/sells gold to defend it).
- **Quantity rule:** fix c for a chosen M and let P_gold float to P_implied. (This is what our formula computes.)

Illustrative plug-in (order-of-magnitude only)

Example: M = $140e12 (global_broad), O = 1.18e9 oz (official),

c = 0.20 => P_implied ≈ ($28e12) / (1.18e9) ≈ $23,700/oz

Caveats (crucial)

- P_implied is a **static** price; the **path** to it depends on thin float, hoarding, futures/lease markets, and policy frictions.
- Coverage of **broad money** is vastly harder than coverage of **base money**; pick one and state it.

- Eligibility matters: retail vs. banks vs. foreign official holders produce very different metal demands.
- Non-gold assets on the CB balance sheet (FX, bills, credit) may be part of the backing; this appendix isolates the **gold leg** on purpose.

2. Which Money? Which Ounces?

Coverage arithmetic is trivial; **choosing the inputs is not**. You must define **what money you promise to convert** and **which ounces you will actually deliver**. Those two choices dominate the implied price.

2.1 Choosing M: base vs. M1 vs. broad money; what is actually "liquid"

Money aggregates (pick one, state it):

- base_money = currency_in_circulation + bank_reserves_at_CB
  Pros: smallest target; closest to the central bank's direct balance sheet.
  Cons: if banks and the public can **transform** deposits into currency at will, promising convertibility on base alone can **pull** broader money toward base, functionally enlarging M.
- M1 = currency_held_by_public + demand_deposits (transactions balances)
  Pros: matches day-to-day liquidity; a natural "convertible on demand" set.
  Cons: very sensitive to payments tech and regulation; high risk of **bank-run dynamics** under a peg.
- M2 (broad) = M1 + savings/time_deposits + retail_MMFs (definitions vary)
  Pros: "cover what people think is money" (safer politically).
  Cons: very large; implies much higher P_implied or else tight **eligibility** rules to bound claims.

What counts as "liquid" under your rule?

- **Eligibility scope:** retail only? banks? non-resident accounts? If eligibility is broad, **substitution** will expand claims on gold (e.g., firms shift into covered deposits).
- **Convertibility window:** on demand, T+2, or at scheduled auctions? Longer windows reduce run risk and the immediate metal call.

- **Quota/cap:** per-account limits or systemic caps bound maximum daily/weekly conversion and tame M's *effective* size.

Transformation risk (how M grows on impact):

- If you back **base** but promise convertibility for **bank liabilities** when presented as currency, banks and depositors will arbitrage the boundary. In practice, M_effective migrates toward **M1** unless you restrict access.
- If you back **M1**, savers may reclassify balances to qualify, pushing M_effective toward **M2**.
- **Design implication:** pair your chosen M with **hard eligibility** and **operational throttles** or accept a higher P_implied.

2.2 Choosing O: official reserves, above-ground stock, or tradable float

Ounce sets (pick one, defend it):

- official_reserves_oz
  Pros: verifiable, immediately mobilizable; aligned with central-bank custody.
  Cons: small relative to money; yields very high P_implied.
- above_ground_oz (all gold ever mined)
  Pros: largest conceivable pool; creates lower P_implied numbers for thought experiments.
  Cons: not all for sale; jewelry/keepsakes and long-term reserves are **sticky**. Treat as an *upper bound*, not a usable stock.
- tradable_float_oz
  Pros: the relevant set for **transition mechanics** (ETFs, bullion banks, producer hedges, near-market jewelry).
  Cons: hard to measure; pro-cyclical (shrinks as hoarding rises). Using float forces a **much higher** P_implied in practice.

Mobilization channels (how O changes along the path):

- **Revaluation unlocks supply:** higher prices draw out scrap/jewelry and official sellers; O_effective rises with P.
- **Policy can enlarge O:** swaps with other CBs, compulsory tender of domestic mine output, differential VAT on exports, or two-tier pricing.

- **But hoarding shrinks float:** once a peg is credible, private holders *reduce* offers, pushing O_effective **down** unless price is set high enough.

Auditability & trust:

- If you anchor on official_reserves_oz, publish **bar lists, locations, assays, encumbrances (swaps/leases)**. Convertibility lives or dies on inventory clarity.
- If you claim access to broader pools (ETF redemptions, domestic jewelry), specify **legal authorities** and **conversion frictions** up front.

2.3 Sensitivity map: how P_implied scales with each choice

Core identity (quantity rule):

P_implied = (c * M) / O

Elasticities (log-linear, copy-safe):

d ln P = d ln c + d ln M - d ln O

Interpretation: +10% on M or c raises price ~10%; +10% on usable ounces lowers it ~10%.

Rule-of-thumb multipliers (illustrative):

- **Aggregate choice:** moving from **base** to **M1** to **M2** typically multiplies M by **~2–5×** each step (jurisdiction-dependent) ⇒ P_implied scales likewise unless eligibility throttles bind.
- **Ounce set:** moving from **official** to **tradable float reduces** O (float << official) ⇒ P_implied jumps; moving from **official** to **above-ground increases** O by **~5–7×** ⇒ P_implied falls by that factor (theoretical only).

Design levers that tame P_implied:

- **Lower c:** fractional cover (e.g., 10–20%) cuts P_implied linearly.
- **Narrow M:** cover only **base** or a **subset** of deposits; pair with eligibility plus pacing (auction windows).
- **Enlarge O:** pre-arranged swaps, strategic purchases **before** announcing coverage, compulsory tender of domestic mine output (politically sensitive).
- **Throttle demand:** quotas per entity/day, conversion fees/spreads, and delayed settlement reduce immediate metal calls without changing the headline c.

Four-quadrant intuition (qualitative):

- **Small M, large O (base + official+swaps):** lowest P_implied; easiest to defend; still vulnerable to credibility shocks.
- **Small M, small O (base + float only):** manageable steady state, but **spiky** transition (thin inventory).
- **Large M, large O (M2 + above-ground):** attractive numbers on paper but **unreal** operationally (most "O" will not tender at modest premia).
- **Large M, small O (M2 + official):** requires **very high** P_implied or strict eligibility; otherwise invites a conversion rush.

Sanity checks before publishing a target:

1. Does the chosen M match **who may convert**? If not, estimate M_effective under likely reclassification.
2. Is your O **audited and unencumbered**? If leased/pledged, haircut it.
3. Does the **path** enlarge O (scrap inflow) faster than it enlarges M (eligibility arbitrage)? If no, your initial P_implied is **too low**.
4. Are **real rates** and **FX** supportive? A strong USD/positive real rates compress the monetary premium and force more of the adjustment into the **price rule** or the **eligibility throttle**.

Bottom line: the formula is easy; **defining M and O is policy**. Most of the "skyrocket or not" debate reduces to these choices and to the operational throttles that keep the transition from turning into a one-way option for everyone *but* the central bank.

3. Scenario Table: 10% / 20% / 40% / 100% Coverage

Below we keep the algebra **static** (quantity rule) to show orders of magnitude. Then we discuss what would actually happen in markets.

Setup (illustrative global numbers used throughout):

- Money to cover, M (global broad): **$140T**
- Ounces available, O_official (official reserves ≈ **36.7k t**): **~1.18B oz**
- Ounces available, O_all (all above-ground ≈ **216k t**): **~6.95B oz**

- Coverage fraction c ∈ {10%, 20%, 40%, 100%}
- Formula (ASCII-safe): P_implied = (c * M) / O

3.1 Using official reserves only (high prices)

This is the hardest version—smallest ounce pool, so the price has to do the heavy lifting.

Coverage c	Implied price P_implied (USD/oz)
10%	**$11,864**
20%	**$23,729**
40%	**$47,458**
100%	**$118,644**

Interpretation & mechanics

- **Why so high?** Official gold is tiny versus broad money; the price must jump to ration claims.
- **Transition reality:** Tradable float is a fraction of official holdings at any moment, so the *path* likely overshoots these static levels before settling.
- **Policy crutches:** Narrow eligibility (who can convert), pacing windows (e.g., weekly tenders), and two-tier markets (official vs. private) are almost inevitable to avoid a one-way rush.

3.2 Using all above-ground gold (lower, still elevated prices)

This is a theoretical upper bound—the world's entire stock (jewelry, bars, coins, CBs, ETFs) is *not* actually for sale, but the arithmetic is informative.

Coverage c	Implied price P_implied (USD/oz)
10%	**$2,013**
20%	**$4,027**
40%	**$8,054**

Coverage c	Implied price P_implied (USD/oz)
100%	**$20,135**

Interpretation & mechanics

- **Looks manageable on paper,** but to mobilize jewelry/keepsakes, price must clear **behavioral stickiness** (sentiment, taxes, cultural norms).
- **Endogenous supply:** Revaluation *does* pull in scrap and ETF redemptions—so O_effective rises with P—but hoarding rises too.
- **Still a revaluation:** Even at 20% coverage, prices lie far above most recent peacetime ranges.

3.3 Regional variants: single-country peg vs. global coordination

A) Single-country peg (national M, national O)

- **Leakage & arbitrage:** If only one country pegs, capital will **relabel** deposits to qualify and arbitrage cross-border spreads—expanding the *effective* M unless eligibility is tight.
- **FX plumbing:** Conversions for non-residents quickly turn into balance-of-payments flows; without controls, the peg also becomes an FX regime.
- **Design levers:**
    - Cover **base money** (smallest M) not broad money;
    - Restrict eligibility (domestic banks only, quotas, settlement windows);
    - Pre-purchase ounces or secure swaps before announcement to enlarge O.
- **Toy example (copy-safe):**
  M = $2T (base), O = 1,000 t = 32,150,746,600 oz, c = 0.20
  → P_implied ≈ ($0.4T) / 32,150,746,600 ≈ $12,441/oz.

B) Block/coalition peg (pooled M, pooled O)

- **Pooling helps** if large reserve holders join (↑ O) and if only **base money** is covered (↓ M).
- **Governance risk:** convertibility across borders needs shared bar lists, audit, settlement standards, and crisis clauses.

- **Two-tier precedent:** A coalition could run an **official window** at the target price while private markets float—reducing leakages but creating political friction.

C) Global coordination

- **Arithmetic becomes gentle** (large O vs. global M) *only* if coverage targets are **low** (e.g., 10–20%) and eligibility is **narrow** (banks/settlement institutions, not retail).
- **Still path-dependent:** Announcement effects, hoarding, and futures/lease-market kinks will dominate the transition. Even coordinated regimes faced these issues (e.g., two-tier experiments).

Reading the sensitivity at a glance

- **Move M up one notch (base → M1 or M1 → M2):** price multiplies roughly in proportion.
- **Move O from official → all above-ground:** price falls by ~**3–7×** (dataset-dependent) *on paper*; reality sits in between (tradable float).
- **Lower c:** linearly reduces P_implied (e.g., halving c halves the price).
- **Operational throttles** (eligibility, quotas, settlement windows) don't change the algebraic P_implied, but they **tame the path** and the peak price required to keep convertibility credible.

4. Market Microstructure and Path Dependence

Policy arithmetic is static; markets are not. The **path** to any gold-backing target runs through thin inventories, plumbing frictions, and reflexive behavior that can dominate the headline formula.

4.1 Stock-to-flow vs. tradable float; why supply is inelastic on the path

Deep stock, thin float.
Let S be above-ground stock (centuries of output) and F annual mine/scrap flow. In practice, the **tradable float** F*—ounces that market makers can source *this month*—is far smaller than F, and a rounding error vs. S. Much of S is tied up as jewelry, long-term CB reserves, or fully allocated holdings.

Short-run supply curve is steep.

- **Mine output:** fixed by mine plans; weeks-to-years to alter.
- **Scrap:** price-elastic but slow; households react with lags and behavioral thresholds.
- **Refiners/logistics:** throughput, assay, and bar-form constraints (e.g., 400-oz to kilobar recast) cap conversion speed.
- **Allocated vs. unallocated:** only **allocated** bars are immediately deliverable; unallocated claims must be turned into metal, drawing on the same tight float.

OTC + exchange plumbing.

- London OTC (good-delivery 400-oz) and COMEX (100-oz) are linked but not frictionless; locational premia and bar-form premia widen in squeezes.
- Clearing members ration balance-sheet; when funding tightens, they shrink inventories, steepening the offer.

Result: even if the *eventual* P_implied looks modest on paper, the **transition price** can overshoot because the first ounces clear against a near-vertical supply curve.

4.2 Hoarding, front-running, and feedback loops

Announcement dynamics (reflexivity).

1. **Rumor/anticipation:** investors buy gold ahead of policy, shrinking F* and raising spot premia.
2. **Official buying begins:** every tender validates the thesis; private sellers lift offers or step back entirely.
3. **Hoarding equilibrium:** as convertibility looks credible, *holding* gold becomes the dominant strategy; voluntary supply dries up unless price gaps higher.
4. **Policy response:** authorities pace tenders, widen bid/ask, or introduce two-tier markets (official window vs. free market). The free price often runs ahead.

Who front-runs?
Bullion banks (inventory), producers (de-hedging), ETFs (net creation), CBs (reserve diversification), households (coins/bars), and macro funds. Each removes float or raises the clearing price for the next ounce.

Feedback loop (copy-safe sketch).

higher expected peg → private demand ↑ → float F* ↓ → spot premium ↑

→ official purchases costlier → expectation of higher target ↑ → demand ↑ (repeat)

Unless the authority sets **sufficiently high** initial prices or imposes **eligibility/pacing** constraints, the loop forces a jumpy path with stop-go windows and occasional market closures.

4.3 Futures, lease rates, and basis during a regime shift

Key rates & relationships (ASCII-safe):

- Let r = cash funding rate; ℓ = gold lease rate (implied cost to borrow metal); σ = storage/fees.
- For a futures contract with time to expiry T, a stylized basis is:

basis ≈ (r - ℓ)*T + σ - convenience_yield

Normal times: r > ℓ and convenience_yield small ⇒ **contango** (futures > spot).
Tight physical: ℓ ↑ (hard to borrow metal), and/or convenience_yield ↑ (value of having bars now) ⇒ **basis compresses or flips** to **backwardation** (spot > futures).

What to expect in a revaluation path:

- **Spot premia widen:** coins/bars trade above paper spot; loco premia (London vs. Zurich vs. Asia) and bar-form premia (400-oz vs. kilobar vs. retail) diverge.
- **Lease market strains:** metal lenders pull back; ℓ spikes; shorts scramble for borrow; forwards get scarce.
- **Registered inventories matter:** exchange "registered" stocks (deliverable) fall; delivery queues form; exchange raises fees or delivery rules.
- **ETF & swap dynamics:** ETF redemptions can *temporarily* add bars to float, but if retail hoards creations instead, float shrinks; central-bank swaps add supply on paper but may be immobilized.
- **Producer behavior:** miners **de-hedge** in rising markets, removing forward offers and steepening the curve; later, extreme prices can induce *over-hedging*, flattening the far end.

Policy choice and the curve:

- **Price rule** (defend a window): the CB sells/buys metal to pin spot, pushing the stress into **basis/lease rates** and quotas.
- **Quantity rule** (buy fixed ounces per period): spot is allowed to jump; futures may gap into backwardation until inventory rebuilds.
- **Two-tier market:** an official window at P_target with restricted eligibility, while the free market floats. Expect a persistent positive **free-market premium** over the official price.

Operational tell-tales of path dependence:

- Rising spot-to-futures backwardation across maturities.
- Spiking lease/borrow rates and "fails to deliver."
- Exploding loco and bar-form premia; refinery backlogs.
- ETF creation/redemption whipsaws; CBs reporting swapped, not outright, ounces.
- Increasing reliance on auctions/tenders with quantity caps instead of continuous quotes.

Takeaway: Futures curves and lease markets don't *eliminate* the need to reprice; they **transmit** scarcity into spreads, premia, and delivery frictions. In a credible revaluation, the microstructure ensures the **path** is jagged, with overshoots and bottlenecks, long before the static P_implied looks "cleared" on paper.

5. Policy Design Space

Design choices—not the algebra—decide whether a gold-backing scheme is credible, affordable, and survivable in stress. Below is a compact menu of options with trade-offs and copy-safe mechanics.

5.1 Full vs. fractional backing; price rule vs. quantity rule

Backing level (coverage c)

- **Full backing (c = 1.00)**
    - *Pros:* hard commitment; simplest message ("every eligible unit is convertible").
    - *Cons:* implies the **highest** P_implied = (M/O); invites runs if price is set too low; concentrates risk on the CB balance sheet.

- **Fractional backing (0 < c < 1)**
    - *Pros:* linear reduction in P_implied; closer to historical practice; room for other reserve assets.
    - *Cons:* forces **eligibility** and **rationing** rules; messaging is harder ("convertible up to… under conditions…").

Operating doctrine

- **Price rule (fix P_target, supply whatever ounces clear)**
    - Mechanics: CB posts two-way quotes at P_target; buys below/sells above; coverage ratio floats endogenously.
    - *Pros:* simple focal point; market-friendly.
    - *Cons:* if P_target is wrong, reserves bleed or money base expands uncontrollably.
- **Quantity rule (fix c for a defined M, let price float to P_implied)**
    - Mechanics: CB announces coverage fraction and eligible M; runs periodic auctions/tenders for conversion.
    - *Pros:* balance-sheet control; less bleed from mis-set prices.
    - *Cons:* market must discover P; path is jumpy; perceived as rationing.

Hybrid

- **Band/corridor:** defend a band [P_low, P_high]; inside, quantity rule; outside, intervene like a price rule.
- **State-contingent switching:** price rule in calm; quantity rule (or suspension) when inventory or real-rate triggers trip.

5.2 Convertibility windows, gold windows, and suspension clauses

Access design

- **On-demand window:** continuous convertibility during market hours.
    - *Pros:* pure. *Cons:* pro-cyclical drain in stress; forces large buffers.
- **Scheduled tenders:** e.g., weekly auctions with pre-announced lots and settlement lags (T+5 to T+10).

- *Pros:* throttles flow; lets refiners/logistics catch up; clearer planning.
- *Cons:* creates event risk; may trade at a premium in secondary markets.

- **Eligibility scope:** retail vs. banks vs. foreign official. Narrower scope shrinks *effective* M.

Gold window architecture

- **Domestic window:** residents only; settle loco domestic vaults; taxes neutralized.
- **Official window:** counterparties limited to banks/CBs; retail pushed to secondary market.
- **FX-linked window:** conversions settle in gold **or** reserve FX at a parity; gives an out when bars are scarce.

Suspension & adjustment clauses (write these up-front)

- **Trigger-based suspension:** automatic pause if inventories fall below X days of tenders, or if lease_rate > L*.
- **Repricing clause:** allow discrete step-changes in P_target or c upon predefined macro triggers (real rates, CPI bands, war powers).
- **Queuing rules:** pro-rata fills or lottery when requests exceed tender size; prevents first-mover advantage spirals.

5.3 Two-tier markets, export controls, and FX plumbing

Two-tier market (official vs. free)

- **Design:** official conversions at P_official with eligibility limits; private price floats (P_free).
- **Use case:** buy time and conserve bars while signaling commitment.
- **Risks:** widening P_free − P_official gap invites leakage, gray channels, and political heat.

Export/import controls

- **Export licenses / VAT differentials:** keep official bars onshore; penalize exporting bullion at the official price.
- **Compulsory tender:** require domestic miners/refiners to offer q% of output to the CB at P_official.

- **Side-effects:** discourages investment if P_official < P_free; necessitates make-whole schemes for producers.

FX plumbing

- **Settlement rails:** define loco (London/Zurich/domestic), bar form (400-oz, kilo, 100-oz), and eligible good-delivery lists.
- **Balance-of-payments:** conversions by non-residents are de facto **FX interventions**; sterilize or cap them (see 5.4).
- **Swap lines:** pre-arranged gold/FX swaps with partner CBs enlarge usable ounces (O_effective) during squeezes.

5.4 Sterilization, balance-sheet mechanics, and seigniorage

Stylized central-bank T-accounts (ASCII)

Before program

Assets: FX_reserves | Gov_bonds | Loans_to_banks | Gold (initial)

Liab.: Currency_in_circ | Bank_reserves | CB_capital

Gold purchase at market (quantity rule path)

CB buys ΔGold at price P →

Assets: Gold +ΔGold

Liab.: Bank_reserves +P*ΔGold (base money expands)

If you want to avoid base expansion (sterilize):

CB sells Gov_bonds (or issues CB bills) amount P*ΔGold →

Assets: Gov_bonds −P*ΔGold ; Liab.: Bank_reserves −P*ΔGold

Net: base money unchanged; asset mix shifts toward Gold.

Gold sale to meet conversions (price rule defense)

Assets: Gold −ΔGold

Liab.: Bank_reserves −P*ΔGold (base money contracts)

(sterilize the contraction if needed by buying bonds)

Seigniorage and revaluation

- **Creation seigniorage:** if the CB **revalues** gold holdings from P_old to P_new, it books a **revaluation reserve** (equity). This can absorb future losses or fund sterilization (subject to statute).
- **Ongoing seigniorage:** spreads/fees on official window conversions; small vs. revaluation effects but helps cover logistics.

Risk management

- **Mark-to-market policy:** if gold is MTM, large drops in P_free can erode CB capital; use revaluation reserves and capital buffers.
- **Encumbrances:** swaps/leases reduce *usable* ounces; publish haircutted O_unencumbered.
- **Duration/carry:** sterilization via bond sales raises market yields; weigh against macro goals (growth, fiscal).

Interaction with macro policy

- **Real rates:** higher real rates compress gold's monetary premium; defending a low P_target becomes cheaper but risks recession via tighter policy.
- **Credit conditions:** draining reserves to sell gold can tighten bank funding; consider targeted refinancing for banks (to separate gold operations from credit stance).
- **Fiscal link:** if the treasury owns most gold, clarify indemnities: who bears P&L of revaluation, sterilization costs, and any conversion losses?

Operational throttles that stabilize the balance sheet

- **Conversion fee/spread:** charge fee% above/below P_official; reduces one-way optionality.
- **Minimum size & bar form:** settle in 400-oz/100-oz bars to deter retail runs; use banks/EMOs to aggregate retail claims.
- **Delayed settlement with penalties for cancelation:** smooths refinery/vault bottlenecks and curbs "optionality for free."

Bottom line. Choose **coverage (c)**, **money (M)**, and **ounces (O)**; then pick an operating rule (**price** vs. **quantity**, or a **band**). Wrap it with eligibility, pacing, and clear **suspension/repricing**

clauses. Finally, **pre-wire the balance sheet** (sterilization tools, revaluation reserves, swap lines). If these levers point the same way, the peg can be credible; if they conflict, the static algebra will be overwhelmed by microstructure stress on day one.

6. Historical Guides and Cautionary Tales

6.1 1933–34 revaluation mechanics

Backdrop. A banking panic and gold outflows forced the U.S. to suspend convertibility domestically (bank holiday, March 1933). Executive orders then **compelled delivery** of most private gold to the Treasury and **abrogated gold clauses** in contracts, severing automatic claims on metal.

The price move. From October 1933 to January 1934, the "gold-buying program" nudged up the official price day by day, then the **Gold Reserve Act (Jan 1934)** fixed $35/oz (from $20.67) — a ~59% jump in the gold price (≈41% dollar devaluation vs. gold).

Balance-sheet plumbing.

- The **Fed transferred its gold** to Treasury and received gold certificates; private ownership stayed restricted.
- The **revaluation profit** (difference between old and new book values) capitalized a **revaluation reserve** and seeded the **Exchange Stabilization Fund (ESF)**—dry powder for FX/gold operations.
- With ownership bans and export controls, arbitrage into the free market was blocked; the U.S. operated a **de facto one-tier official market** at $35 domestically.

Lessons for today.

- Large revaluations are **legal-mechanical** problems if authorities control convertibility and inventory accounting.
- **Controls** (eligibility, ownership, export) are what prevent an announced price from being arbitraged immediately.
- A revaluation can be paired with **sterilization tools** and a revaluation reserve to manage monetary effects.

6.2 Bretton Woods and the 1968 two-tier market

Architecture (1944–1971). Bretton Woods set a **$35/oz official parity** and pegged exchange rates; foreign central banks could convert dollar reserves into U.S. gold. To defend $35 in private markets, the **London Gold Pool (1961–1968)** pooled official sales.

Stress and break. Rising U.S. deficits and credibility strains (late 1960s) triggered heavy gold demand; the Pool hemorrhaged bars and **collapsed in March 1968**.

Two-tier solution (1968–1971).

- **Tier 1 (official):** central banks transacted at $35; they pledged **not to buy** from the private market above $35.
- **Tier 2 (private):** the free price floated (often >$35); London briefly closed, then reopened on a free-market basis.
- Convertibility among official holders persisted, but the **gap between tiers** widened; outflows slowed, not solved.

Coda. Pressure migrated to the official window until **August 1971**, when the U.S. **suspended dollar convertibility** ("closing the gold window"). Parities unraveled; by 1973, major currencies floated and gold priced freely.

Lessons for today.

- A **two-tier regime buys time** and preserves inventory, but it **does not remove** the pricing pressure; it **relocalizes** it.
- Clear **non-arbitrage rules** (officials won't buy from private at premia) are essential; otherwise, the official tier is drained.
- If fundamentals (real rates, external balances) are misaligned, a two-tier system **postpones** rather than prevents repricing.

6.3 Central-bank sales/purchases (1990s–present): lessons on price impact

The 1990s dishoarding era.

- Several European banks **sold sizeable tonnages**, culminating in the UK's 1999–2002 auctions. Sales were transparent but **price-negative in the short run** and damaging to sentiment.

- The **Washington Agreement on Gold (1999)** capped and **telegraphed official sales**, converting a source of shock into a **predictable flow** the market could absorb.

2000s–2010s transition.

- Official sector turned **net buyer** at times; the **IMF's 2009–10 sales** (partly to India) were absorbed without destabilizing the market, illustrating how **pre-announced, negotiated** flows limit impact.
- Growth of ETFs and changes in leasing reduced one-way supply; producer **de-hedging** removed forward offers, steepening bull-market moves.

2020s pattern.

- **EM central banks** (and some developed peers) accumulated gold for **diversification and sanction-resilience**, providing a **structural bid** that cushions dips and raises the long-run floor.

Operational lessons.

- **Surprise, price-insensitive sales** bruise markets; **telegraphed quotas** are largely digested.
- **Steady official buying** functions like a **put** beneath price; persistent official selling like a **call** above it—both shape volatility more than trend.
- **Leasing and swaps** can expand **tradable float** temporarily, softening spikes—but they add encumbrances; only **unencumbered** bars truly back convertibility.
- The market can absorb **hundreds of tonnes per year** when flows are **predictable**; **regime changes** (pegs, windows, tiering) are what create **step-function** price moves.

Policy takeaway. If you aim to (re)introduce gold backing, **borrow from the 1999 playbook** (caps, calendars, transparency) rather than from surprise auctions—and expect that credible, long-lived **official demand** will be self-reinforcing, tightening the tradable float precisely when you most need the metal.

7. Macro Interactions

7.1 Real rates, USD, and the monetary premium

The **monetary premium** in gold is the wedge between extraction cost and market price driven by macro variables. A compact mapping is:

premium_gold = f(- r_real, - USD, + tail_risk, + CB_net_buying)

- **Real rates (r_real):** Lower real yields reduce the opportunity cost of holding a non-yielding asset → premium ↑.
  Rule-of-thumb sensitivity (stylized): a 100 bps drop in long real yields often coincides with a **material** rise in gold's premium; the sign is robust even if the magnitude varies by regime.
- **Dollar (USD):** A stronger USD tightens global financial conditions and mechanically lowers the USD price of globally traded assets → premium ↓ (in USD terms).
  Caveat: if USD strength reflects **r_real ↑**, the two channels reinforce.
- **Tail risk & official flows:** War, default, banking stress, and **net CB buying** raise the premium even with flat real yields.

GLR linkage (Gold-Loaf Ratio):

GLR = P_gold / P_bread_1lb

d ln GLR ≈ β_r * (- d r_real) + β_usd * (- d ln USD) + β_stress * d Stress

+ γ_e * d ln Energy + d ln Y

where γ_e ≈ (s_e^g - s_e^b) and Y is bread-side yield/productivity. In quiet food/energy conditions, **real rates** and **USD** dominate medium-term GLR swings.

Monitoring set: 10y TIPS (or local real), broad USD index, CB gold purchases, gold lease rates, and GLR itself.

7.2 Banking stress and reserve preference

When banking stress rises, the system **reprioritizes reserves**:

1. **Funding & liquidity:** Deposit flight and higher haircuts push banks toward **high-quality liquid assets** (HQLA). Private balance sheets shorten duration; credit creation slows.
2. **Policy response:** Central banks expand backstops (discount windows, liquidity facilities). Two common macro outcomes:
   - **Easing path:** policy cuts/forward guidance → r_real ↓ → gold premium ↑.
   - **Tight funding path:** if policy lags, funding squeezes push up real rates temporarily, but **tail-risk** and **reserve preference** often overpower, keeping the gold bid firm.

3. **Portfolio reallocation:** Households/funds rotate into **claims they trust** (cash/T-bills/gold). If convertibility is being discussed, **option value** amplifies gold demand (front-running the regime).

GLR read-through:

- Numerator: P_gold ↑ via premium (stress + reserve preference).
- Denominator: recessions can **temper energy and grain costs**; with some lag P_bread_1lb may soften (or be policy-smoothed).
- Net: GLR typically **rises** into banking stress, especially when accompanied by falling real yields.

Stress dashboard: FRA-OIS or SOFR-OIS, bank CDS, discount-window usage, gold lease/borrow rates, refinery premia, GLR.

7.3 Energy prices and partial cancellation on the bread/staples side (link to GLR)

Energy shocks hit **both** mining and baking/transport. First-order, much of this **cancels** in GLR:

d ln GLR | energy ≈ (s_e^g - s_e^b) * d ln Energy

- Typical shares (stylized):
  s_e^g (mining energy share) ≈ 0.20–0.35; s_e^b (bread chain) ≈ 0.10–0.20.
  Hence s_e^g - s_e^b often **slightly positive** → a pure energy up-shock nudges GLR **up**, but modestly.
- **Asymmetries that break cancellation:**
  - **Fuel mix:** Open-pit mines are diesel-heavy; bakeries/transport may be gas/electric. A **diesel-specific** spike can raise mining costs more than baking costs → GLR ↑.
  - **Subsidies/price controls:** If governments cap staple prices or VAT-shield bread, P_bread_1lb is **sticky down**, while P_gold still reflects higher mining costs and risk premia → GLR ↑ more than fundamentals alone.
  - **Logistics bottlenecks:** Port/rail constraints raise delivered flour costs disproportionately; in siege/blockade settings the denominator jumps → GLR **falls** even if gold rises.
  - **Tech shifts:** Electrification/renewables at mines vs. gas-intensive ovens can **lower s_e^g relative to s_e^b** over time, reducing γ_e.

Operational use:

- If GLR ↑ while energy/rates are flat, look to **USD** or **stress** for the driver.
- If energy spikes but GLR barely moves, you're seeing **cancellation**; confirm with loco/bar-form premia and wage data.
- If bread is **administered** (controls) and energy soars, expect GLR to **over-react** upward until policy resets or subsidies expire.

Teaching aid: plot GLR with panels for real yields, USD, and an energy index. The eye quickly sees when GLR is doing **macro work** (rates/USD/stress) versus **micro work** (energy/logistics/policy on the bread side).

You said:

Expand: Distributional and Real-Economy Effects 8.1 Who gains, who loses under revaluation 8.2 Credit creation under a peg; deflation risk if price is mis-set 8.3 International spillovers and currency blocs

8. Distributional and Real-Economy Effects

8.1 Who gains, who loses under revaluation

Immediate winners

- **Holders of gold** (households with bars/coins, ETFs, miners' equity, central banks/treasuries): mark-to-market gains; sovereigns book revaluation reserves.
- **Gold-rich jurisdictions** (large official reserves, strong mining sectors): stronger external balance, easier reserve adequacy.
- **Balance sheets hedged to gold** (royalty/streaming firms, some commodities funds): NAV and collateral improve.

Potential losers

- **Holders of unhedged nominal claims** (cash, fixed-rate bonds) if revaluation coincides with currency devaluation and a rise in inflation expectations.
- **Gold-poor sovereigns**: FX reserve adequacy worsens; higher cost to join or defend a peg.
- **Import-dependent households** where pass-through is fast: tradables get dearer before wages adjust.

- **Jewelers and low-margin fabricators**: input costs jump; volumes can contract.

Ambiguous (policy-contingent)

- **Debtors vs. creditors:**
    - If the peg is defended with tight money (rates ↑), real debt burdens **rise** → creditors gain, debtors lose.
    - If revaluation is paired with unsterilized balance-sheet expansion, near-term inflation **lightens** real debts → debtors gain.
- **Inequality:** gold ownership is skewed; windfalls can be regressive unless taxed/recapitalized into public balance sheets (e.g., via revaluation reserves funding social uses).

Sectorally

- **Mining & refining**: capex cycles restart; national content rules may redirect rents domestically.
- **Banks**: lose cheap reserves if convertibility drains liquidity; gain fee income if they intermediate official windows.

8.2 Credit creation under a peg; deflation risk if price is mis-set

Credit mechanics (stylized)

- Under convertibility, banks must honor claims that can be **turned into gold** (directly or via the central bank). Reserve drains tighten funding unless offset.
- Interest rates become the **shock absorber**: to stop outflows the policy rate must rise until gold demand cools.

Price-rule vs. quantity-rule macro

- **Price rule (fix P_target)**
    - If P_target is **too low** (gold undervalued):
        - CB sells gold → base money **contracts** → rates ↑ → credit slows → **deflationary** bias.
        - Chronic outflows risk suspension.
    - If P_target is **too high** (gold overvalued):

        - CB buys gold → base money **expands** (unless sterilized) → rates ↓ → credit grows → **inflationary** bias.

- **Quantity rule (fix coverage c)**
    - Money base impact depends on sterilization:
        - **Unsterilized** gold buying expands base; **sterilized** swaps assets without changing base.
    - Price is discovered in tenders; volatility migrates to **price**, not quantities.

Deflation risk signal (copy-safe)

If P_market > P_target and CB insists on convertibility at P_target:

Gold_outflows ↑ → Reserves ↓ → Monetary_base ↓ → r ↑ → Credit ↓ → Output ↓

If this loop persists, employment and prices fall until parity is credible—or the peg is abandoned or reset.

International channel (price-specie flow redux)

- Current-account deficits drain gold/FX; domestic credit tightens; imports fall; prices/wages adjust downward; parity recovers—**slow and painful** if wages are sticky.

8.3 International spillovers and currency blocs

Spillover map

- **Terms-of-trade shifts:** gold-rich exporters gain external firepower; gold-poor importers face tighter external constraints.
- **Reserve composition:** CBs rebalance toward gold; demand for reserve currencies may fall at the margin, raising funding costs for deficit countries.
- **Capital flows:** arbitrage into the pegging jurisdiction's assets until eligibility/throttles bind; non-residents test the window, turning convertibility into **FX policy**.

Blocs and coordination

- **Single-country peg:** invites cross-border relabeling of deposits to qualify; pressures the **FX** and **capital account**; tends to require controls (eligibility, quotas, export licenses).
- **Regional bloc (pooled reserves):** lowers volatility if governance is credible (bar lists, joint audits, shared rules). Without deep trust, asymmetric shocks reignite internal drains.

- **Global coordination:** lowers the headline P_implied for a given coverage but needs harmonized eligibility and common crisis clauses; otherwise, flows migrate to the weakest link.

Two-tier & trade plumbing

- Expect a **free-market premium** over official price in non-members; gray channels convert that premium into **smuggling/round-trips** unless export controls and VAT design are tight.
- **Settlement rails:** loco choice (London/Zurich/Shanghai/onshore) and bar form (400-oz vs. kilo) shape who can actually settle—becoming policy levers as much as logistics details.

Spillback to macro

- If many CBs accumulate gold at once, the **monetary premium** rises globally (supporting gold) while some FX reserve demand for major currencies ebbs (mild upward pressure on their real yields).
- In a downturn, a rigid peg that forces pro-cyclical tightening propagates **deflationary impulses** across trading partners—unless partners float or counter-ease.

Bottom line: a revaluation is not just a price chart event; it redistributes wealth and risk across **sectors, balance sheets, and borders**. The winners and losers—and whether the economy disinflates or overheats—hinge on three design choices: the **price/quantity rule**, the **coverage/eligibility**, and the **sterilization** stance.

9. Transition Playbook

A credible transition needs **plumbing-first** execution: predictable auctions, transparent dashboards, and pre-authorized fallbacks. Below is a compact, copy-safe playbook.

9.1 Auction/tender mechanics and pacing (avoid sudden stops)

Design the conversion rail as a *program*, not a headline.

(A) Calendar & inventory

- **Fixed cadence:** e.g., weekly tenders every Tue 14:00 local; publish the next 12 dates.

- **Bar form & loco:** 400-oz good-delivery (London/Zurich/onshore) plus 100-oz/kilo as available; state conversion fees/recertification delays.
- **Eligibility:** banks/clearing members first-line; retail aggregates via banks. KYC/AML pre-cleared to avoid gate friction.
- **Inventory disclosure:** publish *unencumbered* ounces by loco/form; show swaps/leases separately.

(B) Auction format (recommend: uniform-price, sealed-bid)

- **Submit:** quantity (oz) and bid price (USD/oz) within a window.
- **Rank:** highest to lowest price until tender size is filled.
- **Clear:** everyone pays the **stop-out** (uniform) price; partial fills at the margin.
- **Why uniform-price?** Minimizes winner's-curse games and reduces volatile bid shading vs. discriminatory.

(C) Tender sizing (pace rule)
Let:

- O_unenc = unencumbered deliverable ounces
- D_ma = moving-average demand (oz/week)
- H = planning horizon (weeks)
- θ = inventory buffer (0.6–0.8)
- κ = responsiveness (0.2–0.4)

Copy-safe rule of thumb:

q_t = min(θ * O_unenc / H , (1 + κ) * D_ma)

- Smooths supply; prevents front-loading that causes a **sudden stop**.
- Publish q_t 3 business days before each auction.

(D) Settlement & fails

- **T+5 to T+10** delivery; penalties for buyer cancelation; maker-of-last-resort clause to source alternate loco/form with stated premium caps.
- **Refinery/vault constraints:** pre-book capacity; publish recast queues.

(E) Circuit breakers

- **Basis guard:** if spot–front-month backwardation > b* or **lease rate** > ℓ*, auto-reduce q_t by 30–50% or slip settlement by +2 days.
- **Bids-to-cover (BTC):** if BTC > X, raise next q_t by min(κ*excess, cap); if BTC < 1.1, reduce.

(F) Anti-cornering

- Per-bidder caps; affiliated-account aggregation; disclosure of >10% allotments; randomization over ties.

(G) Two-way window (optional)

- Standing **sell** window for small lots at P_official + fee; **buy** window at P_official − fee. Keeps liquidity continuous between auctions.

9.2 Communication: coverage targets, dashboards, and triggers

Principle: No surprises. Define, disclose, and pre-commit.

(A) One-pager (pin it)

- **What is covered (M)** and **coverage fraction (c)**.
- **Which ounces (O)** count (unencumbered, by loco/form).
- **Operating rule:** price rule, quantity rule, or band.
- **Eligibility & windows:** who can convert, how often, settlement terms.
- **Fallbacks:** corridor, suspension triggers, price-review mechanics.

(B) Weekly dashboard (standardized)

- **Inventory:** O_unenc by loco/form; days-of-cover at current q_t.
- **Flows:** tender size, bids-to-cover, stop-out, % filled, allotment by tier.
- **Market stress:** spot–front basis, lease rates, loco premia, bar-form premia.
- **Macro:** 10y real rate, USD index, CB net purchases (rolling), GLR.
- **Queues:** pending requests, average settlement time, refinery backlog.

(C) Triggers (copy-safe thresholds; pre-authorize)

Inventory floor: O_unenc < X days of q_t → shrink q_t or widen corridor

Stress: lease_rate > ℓ* OR |basis| > b* → auto-throttle q_t

Demand spike: BTC > B* for 3 auctions → step-up q_t or call review

Repricing review: ≥2 triggers hit OR macro band breach (real r outside R*)

- Publish thresholds (X, ℓ*, b*, B*, R*) up-front; log every activation.

(D) Narrative discipline

- Use the same schema each week; avoid ad hoc commentary.
- Explain deviations **with the pre-set triggers**, not with one-off stories.
- Provide **worked examples** of how P_implied shifts if M, O, or c change.

9.3 Fallbacks: temporary suspension, corridor bands, or price-rule switch

Design **before** day one; legal authority ready.

(A) Temporary suspension (rules-based, time-bound)

- **Triggers:** O_unenc < floor, delivery fails > threshold, refinery outage, or legal injunction.
- **Mechanics:** pause new conversions; honor queued fills pro-rata; offer **cash-at-stop-out + premium** or **FX-at-parity** as interim settlement.
- **Make-whole:** penalty interest to waiting claimants; publish a **re-open schedule**.
- **Communication:** "Clause 7 invoked due to X; next review in 5 business days."

(B) Corridor bands (convertibility band)

- Set [P_low, P_high]. Inside the band, run quantity-rule tenders; outside, intervene like a price rule.
- **Widen** the band automatically under stress (pre-set step size) to avoid binary breaks.
- **Pros:** fewer cliff events; **Cons:** more complexity, requires more comms discipline.

(C) Price-rule switch (when quantity-rule becomes unmanageable)

- **One-time reprice:** announce P_target_new at/beyond recent free-market prints to recenter coverage; optionally pair with **eligibility tightening**.
- **Indexing option:** publish a rule (copy-safe):

$P_{target,t} = P_0 * \exp(\alpha - \beta * r_{real,t})$

where $\beta > 0$ ties the official price inversely to real rates, smoothing stress.

- **Two-tier for stabilization:** maintain an **official window** at $P_{target,t}$ with restricted eligibility while free price floats; review monthly.

(D) Legal & balance-sheet scaffolding

- **Pre-authorize**: suspension power, corridor changes, revaluation accounting, sterilization instruments (CB bills, term repos), indemnities between Treasury/CB.
- **Disclosure**: bar lists, encumbrance reports, audit cadence; revaluation reserves treatment.

(E) Aftercare & exit

- Publish a **backlog burn-down** chart post-suspension.
- Gradually normalize q_t toward steady-state; retire extraordinary premiums/fees in steps.
- Sunset clause: criteria to wind down the program or to migrate to a permanent regime.

Bottom line: Stable transitions come from *mechanics over mystique*: a paced auction calendar, transparent dashboards with hard triggers, and pre-baked fallbacks that everyone can read **before** the first ounce moves.

10. Investor Implications

10.1 Positioning for convexity (bullion vs. miners vs. options)

Core (low-friction exposure): bullion

- **Physical (allocated):** highest integrity; storage/insurance drag; jurisdiction & vault diversification matter.
- **ETFs/grantor trusts:** tight tracking; small fee drag; avoids logistics; check bar lists/loan policies.
- **Futures:** margin-efficient but roll/basis and delivery rules—great for pros, not “set & forget.”

High beta (operating leverage): miners

- **Why convex:** profits ≈ (P_gold − AISC) × volume; when P_gold rises above cost, earnings and NAV re-rate faster than bullion.
- **Risks:** cost inflation (diesel, labor), geology, permitting/jurisdiction, equity beta, hedging.
- **Variants:** royalty/streaming companies (lower cost risk, smoother margins) vs. single-asset producers (spikier upside, higher blow-up risk). Use miners as a **satellite**, not the whole hedge.

Options (defined-risk convexity)

- **LEAPS on bullion ETFs** (e.g., 12–24m calls): convex upside with limited capital; θ (time decay) is the cost of insurance.
- **Call spreads** (buy call, sell higher strike) to blunt θ; **calendars** to express timing views.
- **Vol discipline:** accumulate when implied vol is in its lower historic tercile; scale back when vol spikes.

Practical barbell (illustrative, not advice)

- Small **core bullion** sleeve for carry-through regimes + small **OTM calls** for regime-change convexity; add a **select miners/royalty** sleeve if you accept equity risk. Keep sizing modest and pre-commit rebalance rules.

10.2 Signals to track: coverage talk, CB flows, lease rates, basis kinks

Coverage/convertibility chatter

- Official speeches, draft laws, “gold window,” “coverage ratio,” “convertibility band,” “two-tier market.” Note *which* M and O are named.

Official-sector flow

- Quarterly net **CB purchases/sales**, tender calendars, swap usage; big one-off buys (e.g., >50t) change floors.

Microstructure tightness

- **Lease/borrow rates (ℓ)** spiking, **spot–futures basis** flipping to backwardation, **loco spreads** (Shanghai–London, Zurich), and **bar-form premia** (kilo vs. 400-oz).

- **ETF creations/redemptions** (daily tonnage change), **refinery backlogs**, and retail coin **stockouts**.

Macro anchors

- **Real yields** (10y TIPS or local equivalents), **USD** broad index, **tail-risk** gauges (credit spreads, bank CDS).
- **GLR** (Gold-Loaf Ratio) vs. its band: rising GLR with falling real yields = classic premium expansion.

Dashboard (lightweight)

Rates: 10y real, curve slope

FX: USD broad

Flows: CB net (t/quarter), ETF holdings (oz)

Micro: lease rate, basis (front), loco & bar premia

GLR: level, z-score vs. 10y history

10.3 Rebalance rules around band excursions

Use **rules, not vibes.** Examples you can implement as code or spreadsheet logic:

A) GLR percentile bands (quantity-agnostic)

Compute GLR_t = P_gold_t / P_bread_1lb_t

Find rolling 10y percentiles: p10, p50, p90

If GLR_t < p10 and real_yield_t ↓ (Δ3m < 0):

+1 unit to bullion sleeve (max N units/year)

If GLR_t > p90 and real_yield_t ↑ (Δ3m > 0):

−1 unit from bullion; rotate to bills or reduce miners beta

Else:

hold; rebalance annually back to target weights

B) Z-score with macro confirmation

$z = (GLR_t - mean_{10y}) / stdev_{10y}$

Enter add mode at $z \leq -1$ AND $\Delta real_yield_{6m} \leq 0$

Enter trim mode at $z \geq +1$ OR ($z \geq +0.5$ AND USD ↑ over 3m)

C) Options overlay discipline

- **Buy** 12–24m calls (or call spreads) when GLR $z \leq -0.5$ **and** implied vol in bottom tercile.
- **Roll/trim** when GLR $z \geq +0.5$ **or** vol in top tercile; recycle premium into core bullion if thesis persists.

D) Miners risk-guardrails

- Cap miners at a fixed share of the gold sleeve (e.g., ≤ 40%).
- Cut miners on **AISC** inflation (company guidance + energy spikes) or rising **jurisdiction risk**; replace with royalties or bullion.

E) De-risk triggers (exit/hedge)

- Sustained **positive real yields** (e.g., > +2% for 3 months) + rising USD.
- Telegraphed **official-sector sales** (large, programmatic).
- GLR above p90 while basis normalizes (contango returns) → trim into strength.

Common error modes (avoid)

- Chasing miners as a "levered gold" proxy without managing equity beta and cost inflation.
- Ignoring **tax treatment** (collectibles vs. equity rates) and **vehicle frictions** (storage, spreads).
- Overfitting the band: GLR can sit at extremes for months in true regime shifts.

Bottom line: Pair a **core**, low-drift bullion exposure with **explicit, pre-written rules** that add when GLR is cheap (and macro confirms) and trim when it's rich (and macro pushes against you). Use options for convexity you can sleep with, and keep miners as a governed satellite—not the hedge itself.

11. Limitations and Falsifiers

11.1 Data/measurement pitfalls for M and O

Money to cover (M)

- **Definition drift:** Base, M1, and M2 differ by jurisdiction and over time (sweeps, MMFs reclassified). A time-slice of "M2" is not apples-to-apples across countries.
- **Double counting / shadow money:** Eurodollars, repos, and stablecoins can create near-money claims not in headline aggregates; conversely, some "money" is legally ineligible to convert. You must define **eligible M_effective**, not headline M.
- **FX translation:** Summing global M in USD requires same-day FX; mismatched dates add noise.
- **Seasonality & revisions:** Aggregates are revised; seasonal bulges (tax, holidays) can distort M if you pick a single date.
- **Leakage risk:** Eligibility rules can **expand** M_effective as balances migrate toward covered forms (transactions → demand deposits).

Ounces available (O)

- **Encumbrances:** Official and ETF bars may be **leased**, **swapped**, or otherwise pledged. Only **unencumbered** ounces back convertibility.
- **Tradable float vs. stock:** Above-ground estimates include jewelry/keepsakes not realistically offered near spot. The **float** is the binding constraint during transition.
- **Bar form & loco:** 400-oz (London) vs. 100-oz (COMEX) vs. kilobars (Asia) aren't perfectly fungible at speed; recast/assay delays shrink short-run O_effective.
- **Assay/fineness:** "Good delivery" vs. non-standard bars; purity losses and fees matter in bulk conversions.
- **Reporting opacity/lag:** Some sovereign holdings are opaque; ETF creations/redemptions post with delay.
- **Rehypothecation chains:** Multiple claims on the same metal (unallocated accounts) inflate perceived O.

Bottom line: Coverage arithmetic is only as good as **M_effective** and **O_unencumbered, float**—two quantities easy to **overstate**.

11.2 What evidence would refute the coverage-pricing thesis

The thesis: for a chosen M, usable O, and coverage c, the market must **reprice** gold toward P_implied = (c*M)/O, with path dependence (thin float). Convincing refuters would show that **no large repricing is needed** *and* microstructure stays loose.

Refuters (any one is strong):

1. **Operational counterexample:** A jurisdiction offers **broad, on-demand convertibility** (clearly defined M, open eligibility) at a target far **below** P_implied, and sustains it **without** rationing, queues, two-tier pricing, or capital controls for years. (Implies our O or M mapping is wrong.)
2. **Cross-section disproportionality:** Across countries/periods with credible coverage programs, changes in P_gold **do not scale** with Δ(c*M/O) (after controlling for real rates/USD). (Implies the formula lacks predictive content.)
3. **Microstructure non-tightness:** During a serious coverage push, **lease rates** stay flat, **basis** stays in contango, **loco/bar premia** don't widen, and deliverable inventories don't fall—yet conversions proceed smoothly. (Implies float is far larger than assumed.)
4. **Audit shock on O:** High-quality audits reveal **usable, unencumbered** ounces are an order of magnitude **larger** than standard estimates (e.g., hidden sovereign stockpiles freely mobilized). (Our O too low.)
5. **Effective M much smaller:** Durable evidence that eligibility/pacing rules keep **M_effective ≪ headline M** *even after* substitution incentives—so that realistic P_implied is close to spot. (Our M too high.)
6. **Event-study nulls:** Repeated, credible policy steps toward convertibility produce **no persistent price, basis, or lease-rate response**, contrary to the thesis that markets must tighten on the path.

Weaker but suggestive refuters: Robust models showing wage/energy co-movement and real-rate channels cannot explain historical gold/bread ratios or revaluation episodes (conflicts with our broader framework).

11.3 Alternative anchors (commodities basket, SDR-style mixes)

If gold is politically or operationally costly as a sole anchor, alternatives can **share the load** or **dilute idiosyncratic shocks**.

(A) Commodities basket (energy + metals + agri)

- **Design:** hold a vector of quantities O_i in assets i ∈ {oil, copper, wheat, …, gold} and target coverage c.
- **Arithmetic (quantity rule, ASCII-safe):**

Let p_i be market prices, O_i the held quantities.

Coverage constraint: c*M = Σ_i (p_i * O_i)

Solve for weights W_i or required reprice of the basket; avoid roll-heavy futures if possible.

- **Pros:** diversification; ties money to **real inputs** of the economy.
- **Cons:** storage/roll costs (contango), perishability, political optics (holding food), higher operational complexity.

(B) SDR-style financial mix (FX + gold)

- **Design:** holdings in USD/EUR/JPY/GBP/CNY reserves **plus** some gold.
- **Pros:** liquid, low storage cost; spreads currency risk; easy sterilization.
- **Cons:** re-imports fiat policy risk; still needs a **rule** (price or quantity) to avoid discretion drift.

(C) Gold + T-bills corridor

- **Design:** defend a corridor for the **gold/bills** mix value per unit of money; let the mix flex with real rates.
- **Pros:** cushions rate shocks; less violent revaluation needs.
- **Cons:** more moving parts; messaging harder than a single anchor.

(D) CPI or wage indexation (no hard asset)

- **Design:** stabilize purchasing power directly (CPI or median wage targets).
- **Pros:** aligns with real living standards; no storage/logistics.
- **Cons:** relies on statistical agencies and policy credibility; does **not** solve reserve-asset diversification.

(E) Implementation notes

- **Eligibility & convertibility:** even with baskets, you must specify *who* can convert and *into what* (physical, FX, cash equivalent).
- **Governance:** publish rulebooks (weights, rebalancing, audit cadence).
- **Stress tools:** corridor bands, tender calendars, and suspension clauses still apply.

Takeaway: baskets and SDR-style mixes can **lower the required step-reprice** versus a gold-only peg and may better align with today's economy, but they **raise operational and governance complexity**. Any anchor must answer the same questions: *which money, which assets, what coverage, and what is the rule when stress hits?*

Appendix A: Copy-safe formulas and unit conversions (base/M1/M2; tonnes↔ounces)

A.1 Units, symbols, and constants (ASCII-safe)

Troy mass (used for precious metals)

1 troy ounce (oz) = 31.1034768 grams (g)

1 kilogram (kg) = 32.1507466 troy oz

1 metric tonne (t) = 1,000 kg = 32,150.7466 troy oz

Do NOT use avoirdupois ounce (28.3495231 g) for gold.

Price unit translations

P_usd_per_oz → P_usd_per_g = P_usd_per_oz / 31.1034768

P_usd_per_oz → P_usd_per_kg = P_usd_per_oz * 32.1507466

P_usd_per_oz → P_usd_per_t = P_usd_per_oz * 32,150.7466

FX normalization

If inputs are mixed currencies, convert on same date:

X_usd = FX_usd_per_loc * X_loc

(Apply to both M and P_bread or any compared series to avoid spurious ratios.)

A.2 Money aggregates (define what you cover)

Headline definitions (country-specific labels vary)

base_money = currency_in_circulation + bank_reserves_at_central_bank

M1 = currency_held_by_public + demand_deposits

M2 (broad) = M1 + savings_deposits + small_time_deposits + retail_MMFs

global_Mx = SUM_over_countries(local_Mx * FX_usd_per_local)

Effective money eligible for conversion (what really matters)

Let:

M_headline = one of {base_money, M1, M2}

eta_elig = fraction of M_headline that is legally eligible to convert (0..1)

lambda_migrate = fraction of ineligible balances that reclassify to become eligible (0..1)

cap_prog = program cap on total eligible conversions (USD)

Then:

M_eligible_raw = eta_elig * M_headline

M_migration = lambda_migrate * (1 - eta_elig) * M_headline

M_eligible = min(M_eligible_raw + M_migration, cap_prog_if_any)

Use M_eligible (not the headline M) in pricing unless you explicitly promise coverage of the full aggregate.

Time averaging (reduce seasonality/noise)

M_bar = moving_average(M_eligible, window = 3 to 6 months)

A.3 Ounce sets (official, above-ground, tradable float)

Book ounces

O_official_oz = fine ounces held by CB/Treasury (book)

O_aboveground_oz = total fine ounces ever mined and extant (world stock)

Usable ounces for convertibility (haircut encumbrances and form)

Inputs:

lease_encumbrance = share of O_official out on lease/swap (0..1)

form_haircut = share not in deliverable bar form/loco (0..1)

legal_haircut = share restricted by law/jurisdiction (0..1)

O_unenc = O_official_oz * (1 - lease_encumbrance) * (1 - form_haircut) * (1 - legal_haircut)

Short-run tradable float (the binding constraint on the path)

O_float = O_unenc

+ ETF_redeemable_oz_available_today

+ scrap_inflow_oz_at_current_price

+ swap_lines_oz_drawn

- operational_buffers_oz

Use O_unenc for steady-state coverage arithmetic; use O_float for **transition pacing**.

A.4 Coverage and implied price (quantity rule)

One-asset anchor (gold only)

Inputs: coverage c in [0..1], money M = M_eligible (USD), ounces O = O_unenc (oz)

P_implied_usd_per_oz = (c * M) / O

Required purchases at a chosen target price (reverse problem)

Given P_target and current O_unenc:

O_required = (c * M) / P_target

O_to_buy = max(O_required - O_unenc , 0)

If you care about steady-state AND daily pacing

Daily_tender_size_oz = min(O_float / horizon_days ,

pace_factor * rolling_avg(daily_demand_oz))

A.5 Multi-asset anchors (optional extensions)

Gold + foreign reserves (value coverage)

Let V_fx = current USD value of non-gold reserve assets (USD)

Let O = usable gold ounces

Coverage condition: c * M = V_fx + P * O

Solve for P:

P_implied = (c * M - V_fx) / O

Commodity basket (vector form)

Let p_i = price of asset i (USD/unit), Q_i = held quantity of asset i (units)

Coverage: c * M = SUM_i(p_i * Q_i)

If P_gold is the only free variable and others fixed:

P_gold_implied = (c * M - SUM_{i != gold}(p_i * Q_i)) / O_gold

---

A.6 Balance-sheet and revaluation identities (copy-safe)

Gold purchase (unsterilized)

CB buys ΔO oz at price P → Assets: Gold + (ΔO); Liab: Bank_reserves + (P*ΔO)

(base money expands by P*ΔO)

Sterilization

To neutralize base expansion, CB sells Gov_bonds amount P*ΔO:

Assets: Gov_bonds − (P*ΔO) ; Liab: Bank_reserves − (P*ΔO)

Revaluation reserve (mark-to-market)

If book ounces O_cb are revalued from P_old to P_new:

reval_gain_usd = (P_new − P_old) * O_cb

CB_equity_revaluation_reserve += reval_gain_usd

A.7 Rounding, units, and sanity checks

Safe rounding for publication

P_usd_per_oz: nearest $1 (near-term), $10 (long-horizon tables)

Ounces (O): nearest 1,000 oz (country), nearest 0.1 t (international)

Tonnes: 3 to 1 decimal places depending on scale

Percentages: 1 decimal place for c, eta_elig, haircuts

Sanity checks

1) Dimensional: (USD) / (oz) for prices; (oz) for O; (USD) for M.

2) Boundaries: 0 <= c, eta_elig, lambda_migrate, haircuts <= 1

3) O_unenc <= O_official_oz ; O_float <= O_unenc + near-term inflows

4) If P_implied << current spot while offering broad on-demand convertibility,

either M_eligible is understated or O_unenc is overstated.

A.8 Worked mini-examples (plug-and-play)

Example 1: Implied price with official reserves only

M_eligible = $5.0e12

c = 0.20

O_official_oz = 1.18e9

lease_encumbrance = 0.10

form_haircut = 0.05

legal_haircut = 0.00

O_unenc = 1.18e9 * (1 - 0.10) * (1 - 0.05) = 1.006e9 oz

P_implied = (0.20 * 5.0e12) / 1.006e9 ≈ $9937/oz

Example 2: Required ounces at a chosen target price

Target P_target = $12,000/oz

Same M_eligible = $5.0e12 ; c = 0.20

O_required = (0.20 * 5.0e12) / 12,000 = 8.333e7 oz

O_to_buy = max(8.333e7 − 1.006e9 , 0) = 0 (already covered)

Example 3: Gold + FX reserves (value coverage)

M_eligible = $2.5e12

c = 0.40

V_fx = $0.6e12

O_unenc = 2.50e8 oz

P_implied = (0.40 * 2.5e12 − 0.6e12) / 2.50e8

= (1.0e12 − 0.6e12) / 2.50e8

= 0.4e12 / 2.50e8 = $1600/oz

Example 4: Tonnes↔ounces quick checks

If O_unenc_tonnes = 1,000 t, then O_unenc_oz = 1,000 * 32,150.7466 = 3.21507466e7 oz

If P = $3,000/oz, the USD value of 1,000 t = 3.21507466e7 * 3,000 ≈ $96.45e9

A.9 Minimal pseudocode (ready to paste)

```
# Inputs (USD, oz)
M_headline, eta_elig, lambda_migrate, cap_prog
O_official_oz, lease_encumbrance, form_haircut, legal_haircut
c

# Step 1: effective money
M_eligible_raw = eta_elig * M_headline
M_migration    = lambda_migrate * (1 - eta_elig) * M_headline
M_eligible     = min(M_eligible_raw + M_migration, cap_prog if defined else +inf)

# Step 2: usable ounces
O_unenc = O_official_oz * (1 - lease_encumbrance) * (1 - form_haircut) * (1 - legal_haircut)
```

Step 3: implied price

P_implied = (c * M_eligible) / O_unenc

Optional: target price to ounces required

O_required = (c * M_eligible) / P_target

O_to_buy   = max(O_required - O_unenc, 0)

This appendix gives you all the **unit conversions**, **clean formulas**, and **haircut conventions** needed to reproduce (or audit) any coverage/price scenario in a spreadsheet or script without ambiguity.

Appendix B: Scenario calculators (CSV/JSON schema) and reproducibility notes

B.1 File pack overview (what to ship)

/scenarios/

scenarios.csv # row-per-scenario inputs + outputs

scenarios.jsonl # JSON Lines, one scenario per line (same fields)

README.md # units, rounding, sources, method

assumptions.txt # haircuts, eligibility, FX date, parameter defaults

version.txt # semantic version, e.g., CoverageCalc_v1.3

audit/ # optional: bar lists, CB/ETF sourcing notes

B.2 CSV schema (single table; inputs + derived outputs)

Header (copy-paste)

scenario_id,date_fx,ccy_M,M_headline,M_agg_label,eta_elig,lambda_migrate,cap_prog_usd,

ccy_gold,P_spot_usd_per_oz,c,coverage_rule,

O_official_tonnes,lease_encumbrance,form_haircut,legal_haircut,

O_etf_redeemable_tonnes,O_scrap_near_term_tonnes,O_swap_lines_tonnes,operational_buffers_tonnes,

pace_horizon_days,pace_factor,

P_implied_usd_per_oz,O_unenc_tonnes,O_unenc_oz,O_required_tonnes,O_to_buy_tonnes,

O_float_tonnes,daily_tender_size_oz,coverage_achieved,notes

Field notes (units and meaning)

- scenario_id (string): unique key, e.g., US-Base-20pct-2025Q3.
- date_fx (YYYY-MM-DD): FX snapshot date for translating M if multi-currency.
- ccy_M (ISO): currency of headline M before translation (use USD if already USD).
- M_headline (number): headline money aggregate value (in ccy_M).
- M_agg_label (enum): base, M1, M2, global.

- eta_elig (0..1): fraction of M_headline legally eligible.
- lambda_migrate (0..1): migration share from ineligible to eligible forms.
- cap_prog_usd (number or blank): program cap; if blank, no cap.
- ccy_gold (ISO): currency used for gold pricing (should be USD for P_implied).
- P_spot_usd_per_oz (number): current spot (for context; not used by formula unless you choose).
- c (0..1): target coverage fraction.
- coverage_rule (enum): quantity (compute P_implied) or price (compute O_required given an external P_target; if price, set P_implied_usd_per_oz to P_target in input or leave blank and compute).
- **Ounces and haircuts (inputs)**
    - O_official_tonnes (number): book official gold.
    - lease_encumbrance, form_haircut, legal_haircut (0..1 each): multiplicative haircuts.
    - Near-term float adders (tonnes): O_etf_redeemable_tonnes, O_scrap_near_term_tonnes, O_swap_lines_tonnes; subtractor operational_buffers_tonnes.
- **Pacing params (optional)**
    - pace_horizon_days (int): inventory horizon for smooth tenders (e.g., 60).
    - pace_factor (0..1): responsiveness vs. rolling demand (e.g., 0.3).
- **Derived outputs (to be filled by calculator)**
    - P_implied_usd_per_oz (number): (c * M_eligible_usd) / O_unenc_oz.
    - O_unenc_tonnes, O_unenc_oz: haircutted official ounces.
    - O_required_tonnes: (c * M_eligible_usd) / P_target (only for price rule) converted to tonnes.
    - O_to_buy_tonnes: max(O_required - O_unenc, 0).
    - O_float_tonnes: short-run tradable float (unenc + adders − buffers).

- daily_tender_size_oz: min(O_float_oz / pace_horizon_days, pace_factor * rolling_demand_oz) (put NA if pacing not used).
- coverage_achieved (0..1): (P_spot * O_unenc_oz) / M_eligible_usd (context).
- notes (string): plain-English assumptions or data caveats.

Minimal example rows

US-Base-20pct-2025Q3,2025-09-16,USD,2.00e12,base,0.95,0.10,,USD,3700,0.20,quantity,

1000,0.10,0.05,0.00,

50,25,0,20,

60,0.30,

?, ?, ?, ?, ?,

?, ?, "Base-only 20% with modest haircuts"

Global-M2-20pct-Official,2025-09-16,USD,1.40e14,M2,0.60,0.10,,USD,3700,0.20,quantity,

36700,0.10,0.05,0.00,

800,600,400,300,

90,0.25,

?, ?, ?, ?, ?,

?, ?, "Illustrative global broad money with official-only ounces"

(Use the calculator to populate ? outputs.)

B.3 JSON Lines schema (machine-friendly)

One scenario per line (keys mirror CSV)

```
{
  "scenario_id": "US-Base-20pct-2025Q3",
  "date_fx": "2025-09-16",
  "ccy_M": "USD",
  "M_headline": 2.0e12,
```

"M_agg_label": "base",

"eta_elig": 0.95,

"lambda_migrate": 0.10,

"cap_prog_usd": null,

"ccy_gold": "USD",

"P_spot_usd_per_oz": 3700,

"c": 0.20,

"coverage_rule": "quantity",

"O_official_tonnes": 1000,

"lease_encumbrance": 0.10,

"form_haircut": 0.05,

"legal_haircut": 0.00,

"O_etf_redeemable_tonnes": 50,

"O_scrap_near_term_tonnes": 25,

"O_swap_lines_tonnes": 0,

"operational_buffers_tonnes": 20,

"pace_horizon_days": 60,

"pace_factor": 0.30,

"P_implied_usd_per_oz": null,

"O_unenc_tonnes": null,

"O_unenc_oz": null,

"O_required_tonnes": null,

"O_to_buy_tonnes": null,

"O_float_tonnes": null,

"daily_tender_size_oz": null,

"coverage_achieved": null,

```
  "notes": "Base-only 20% with modest haircuts"
}
```

B.4 Calculator rules (formulas; paste into any language)

Constants

```
OZ_PER_TONNE = 32150.7466
```

Effective money (USD)

```
M_eligible_usd = min( (eta_elig + (1 - eta_elig)*lambda_migrate) * M_headline_usd,
                     cap_prog_usd if provided else +inf )
```

Usable ounces (unencumbered)

```
O_unenc_tonnes = O_official_tonnes
               * (1 - lease_encumbrance)
               * (1 - form_haircut)
               * (1 - legal_haircut)
O_unenc_oz     = O_unenc_tonnes * OZ_PER_TONNE
```

Quantity rule (compute price)

```
if coverage_rule == "quantity":
   P_implied_usd_per_oz = (c * M_eligible_usd) / O_unenc_oz
```

Price rule (compute ounces)

```
if coverage_rule == "price":
   require P_implied_usd_per_oz (as P_target)
   O_required_oz     = (c * M_eligible_usd) / P_implied_usd_per_oz
   O_required_tonnes = O_required_oz / OZ_PER_TONNE
   O_to_buy_tonnes   = max(O_required_tonnes - O_unenc_tonnes, 0)
```

Float and pacing (optional)

```
O_float_tonnes = O_unenc_tonnes
```

+ O_etf_redeemable_tonnes

+ O_scrap_near_term_tonnes

+ O_swap_lines_tonnes

- operational_buffers_tonnes

daily_tender_size_oz = min((O_float_tonnes * OZ_PER_TONNE) / pace_horizon_days ,

pace_factor * rolling_avg_daily_demand_oz)

Context metric

coverage_achieved = (P_spot_usd_per_oz * O_unenc_oz) / M_eligible_usd

---

B.5 Validation and QA checks (automate these)

DIMENSION CHECKS

- All haircuts, eta_elig, lambda_migrate ∈ [0,1]

- O_unenc_tonnes ≤ O_official_tonnes

- If coverage_rule == "price": P_implied_usd_per_oz (target) > 0

- If coverage_rule == "quantity": P_implied_usd_per_oz must be computed, not input

SANITY CHECKS

- coverage_achieved ∈ [0, 1.5] (flag if >1.5 unless price way above spot)

- daily_tender_size_oz ≤ (O_float_tonnes * OZ_PER_TONNE) / pace_horizon_days

- If P_implied << P_spot while eligibility broad → warn: M_eligible likely understated

- If O_to_buy_tonnes >> 0 and cap_prog_usd present → warn: cap may bind

CONSISTENCY

- date_fx is same across scenarios in a batch (or justify)

- c, M_agg_label, haircuts documented in assumptions.txt

B.6 Reproducibility notes (how to rerun end-to-end)

Step 0 — Freeze assumptions

- FX date

- haircuts: lease_encumbrance, form_haircut, legal_haircut

- eligibility: eta_elig, lambda_migrate

- pacing: pace_horizon_days, pace_factor (if used)

- rounding: as in Appendix A.7

Step 1 — Normalize money

Convert M_headline to USD at date_fx.

Compute M_eligible_usd using the eligibility/migration/cap rules.

Step 2 — Normalize ounces

Convert tonnes→oz.

Apply haircuts to get O_unenc; compute optional O_float using adders/buffers.

Step 3 — Compute target

If quantity rule: compute P_implied.

If price rule: compute O_required and O_to_buy.

Step 4 — Populate outputs

Fill P_implied_usd_per_oz, O_unenc_*, O_required_*, O_to_buy_*, O_float_*, daily_tender_size_oz, coverage_achieved.

Step 5 — QA

Run validation checks (B.5). Flag rows with violations; append 'notes'.

Step 6 — Version & publish

- Increment version.txt if assumptions change.

- Export scenarios.csv and scenarios.jsonl.

- Update README.md with:

  * scope and dates,

* definitions of M and O,

* formulas cited (Appendix A & B),

* any deviations from defaults.

B.7 Worked example (filled outputs)

scenario_id: US-Base-20pct-2025Q3

date_fx: 2025-09-16

M_headline (USD): 2.00e12 ; M_agg_label: base

eta_elig: 0.95 ; lambda_migrate: 0.10 ; cap_prog_usd: (blank)

M_eligible_usd = (0.95 + 0.05*0.10) * 2.00e12 = 1.95e12

O_official_tonnes: 1000

haircuts: 0.10, 0.05, 0.00 → O_unenc_tonnes = 1000*(0.9*0.95*1.0) = 855.0

O_unenc_oz = 855.0 * 32150.7466 = 2.751e7 oz

c: 0.20 ; coverage_rule: quantity

P_implied = (0.20 * 1.95e12) / 2.751e7 ≈ $14,188/oz

Float adds: +50 +25 +0 −20 = +55 t → O_float_tonnes = 910.0

pace_horizon_days: 60 ; pace_factor: 0.30

daily_tender_size_oz = (910*32150.7466)/60 ≈ 487,289 oz/day (if not limited by demand)

coverage_achieved at spot 3700:

= (3700 * 2.751e7) / 1.95e12 ≈ 0.0522 (≈5.2% covered at spot)

B.8 Minimal CLI-style pseudocode (batch runner)

```
load scenarios.csv
for row in rows:
  M_usd = fx(row.M_headline, row.ccy_M, row.date_fx)
  M_elig = min( (row.eta_elig + (1 - row.eta_elig)*row.lambda_migrate) * M_usd,
              row.cap_prog_usd or +inf )

  O_unenc_t = row.O_official_tonnes * (1 - row.lease_encumbrance)
                                * (1 - row.form_haircut)
                                * (1 - row.legal_haircut)
  O_unenc_oz = O_unenc_t * 32150.7466

  if row.coverage_rule == "quantity":
     P_implied = (row.c * M_elig) / O_unenc_oz
  else:
     P_target = row.P_implied_usd_per_oz  # provided as target
     O_req_oz = (row.c * M_elig) / P_target
     O_req_t  = O_req_oz / 32150.7466
     O_to_buy = max(O_req_t - O_unenc_t, 0)

  O_float_t = O_unenc_t + row.O_etf_redeemable_tonnes
                    + row.O_scrap_near_term_tonnes
                    + row.O_swap_lines_tonnes
                    - row.operational_buffers_tonnes
  if row.pace_horizon_days and row.pace_factor:
     daily_tender = min( (O_float_t*32150.7466)/row.pace_horizon_days,
```

row.pace_factor * rolling_demand_oz())

coverage_achieved = (row.P_spot_usd_per_oz * O_unenc_oz) / M_elig

write outputs; run QA; append notes on any flags

save scenarios_out.csv / scenarios.jsonl

B.9 Publishing checklist

- **Units**: all money in USD; gold in **troy** ounces/metric tonnes.
- **FX date** documented; date_fx present in every row.
- **M definitions** (base/M1/M2) and eligibility rules stated; migration rationale included.
- **Haircuts** justified (leases, form, legal); bar forms/loco disclosed in README.
- **Coverage rule** (quantity or price) set; implied fields computed accordingly.
- **Validation** run; any anomalies explained in notes.
- **Version bump** when any default (haircut, eligibility, FX) changes.

This appendix gives everything needed to **replicate**, **audit**, and **extend** any coverage-price scenario—by spreadsheet, script, or database—without ambiguity.

References

Gold market structure, data, and costs

- World Gold Council (WGC). *Goldhub Data* (above-ground stocks, central-bank demand, ETFs, mine production).
- World Gold Council (2013; updated). "All-in sustaining costs (AISC) and all-in costs—Guidance Note."
- U.S. Geological Survey (annual). *Mineral Commodity Summaries: Gold* and *Minerals Yearbook: Gold*.
- London Bullion Market Association (LBMA). *Good Delivery Rules*; historical notes in *Alchemist* magazine.
- CME Group (COMEX). *Gold Futures* contract specs and delivery rules.

Monetary history and convertibility regimes

- Eichengreen, B. (1992). *Golden Fetters: The Gold Standard and the Great Depression, 1919–1939*. Oxford University Press.
- Bordo, M., & Kydland, F. (1995). "The Gold Standard as a Rule." *Explorations in Economic History*, 32(4).
- Rockoff, H. (1984). "Some Evidence on the Real Price of Gold, Its Costs of Production, and Commodity Prices." *In A Retrospective on the Classical Gold Standard*.
- Jastram, R. (1977); Jastram & Leyland (2009). *The Golden Constant: The English and American Experience*. Wiley; Edward Elgar.
- U.S. Government (1933). Executive Order 6102 (gold hoarding).
- U.S. Congress (1934). *Gold Reserve Act*.
- IMF (1944). *Articles of Agreement* (Bretton Woods); various Annual Reports on the two-tier gold market (1968–71).
- Bank for International Settlements (BIS). Annual Reports covering the London Gold Pool and the 1968 two-tier system.
- The Washington Agreement on Gold / Central Bank Gold Agreements (1999, 2004, 2009). Communiqués and quotas.
- IMF (2009–2010). Reports on IMF gold sales (to India and others).

Gold price drivers and macro links

- Erb, C. B., & Harvey, C. R. (2013). "The Golden Dilemma." *Financial Analysts Journal*, 69(4). (and 2020s updates/working papers).
- Baur, D. G., & Lucey, B. M. (2010). "Is Gold a Hedge or a Safe Haven?" *The Financial Review*, 45(2).
- Alquist, R., Chinn, M., & Coibion, O. (2019). "What Drives Gold Prices?" *Chicago Fed Letter*, 422.

Money aggregates and definitions

- Board of Governors of the Federal Reserve System / FRED. Definitions and time series for *Monetary Base*, *M1*, *M2*.
- BIS & IMF. Cross-country monetary statistics and methodology notes (IMF Monetary and Financial Statistics Manual).

Market microstructure (lease, basis, logistics)

- LBMA. Historical commentary on GOFO/lease markets; vaulting standards.
- CME Group. Delivery notices, registered vs. eligible inventories.
- Refiners' associations and good-delivery lists for bar-form/assay standards (London/Zurich/Asia kilobar).

Historical prices and episodes (context)

- Officer, L., & Williamson, S. *MeasuringWorth*: historical gold prices and CPI series (method notes).
- LBMA *Alchemist* archives (e.g., Jan 1980 spike retrospective; London market closures/reopenings).

Bread/staples cross-checks (for GLR references used in macro sections)

- Phelps Brown, E. H., & Hopkins, S. V. (1955). "Seven Centuries of Building Wages." *Economica*, 22(87).
- Ross, A. S. C. (1956). "The Assize of Bread." *Economic History Review*, 9(2).
- Davis, J. (2004). "Baking for the Common Good: A Reassessment of the Assize of Bread in Medieval England." *Economic History Review*, 57(3).

- Federation of Bakers (UK). “History of Bread” factsheets (for loaf-weight norms and modern kcal/loaf anchors).

Notes: This list groups sources by purpose: (i) hard data (stocks/flows/costs), (ii) legal/archival texts on convertibility regimes, (iii) empirical links to real rates/USD/safe-haven demand, (iv) operational plumbing (lease, basis, delivery), and (v) cross-checks for the Gold-Loaf Ratio used in comparative sections.